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TYPHOID FEVER AT ALBANY, N. Y.[1]

AN ACCOUNT OF THE RECENT OUTBREAK DUE TO USE OF RAW HUDSON RIVER WATER FOLLOWING FLOODING OF FILTRATION PLANT.

By THEODORE HORTON, Chief Engineer, New York State Department of Health.

The typhoid-fever outbreak which occurred at Albany, N. Y., in April, 1913, constitutes one of the most interesting and striking examples of an explosive epidemic due to a sudden and, in some respects, accidental infection of a water supply resulting from the flooding of the slow sand filtration plant.

From April 1 to May 5, inclusive, there were reported some 180 cases, certain detailed information concerning 175 of which I have been able to secure through the local board of health and show on the accompanying diagram. The first cases were reported on April 21, and since that time additional cases have been reported daily until the number on May 5 reached about 180. Owing to the system adopted and in force by the Albany health department in reporting and investigating cases of communicable diseases, and to the unfortunate circumstances that Albany (with three other cities in this State) is exempt from the operations of the public-health law requiring that communicable diseases be reported to the State department of health, considerable difficulty was experienced in the beginning in getting closely in touch with the situation and in securing the necessary information to study and follow the progress of the epidemic.

Through the courtesy of the local health department, however, and upon special request and arrangements the State department of health was able to secure without delay certain essential information of limited amount concerning nearly all cases reported. From this data it appears that of the 175 cases above referred to approximately 75 per cent were among children and 25 per cent among adults. Of the cases among children some 58 per cent were males and 42 per cent females; whereas of the cases among adults about 46 per cent were males and 54 per cent females.

The accompanying diagram shows more strikingly than I can describe the history of this epidemic, which was beyond a doubt traceable to recent floods in the Hudson River which inundated and put out of service the filtration works located near the river just above the city. The events leading up to and immediately following the inundation of the filtration works were described in the Engineering News of April 10, 1913 (pp. 754–755), which should be carefully read in order to understand intelligently the course, extent, and relation of the present outbreak of typhoid fever to conditions during and immediately following the flood.

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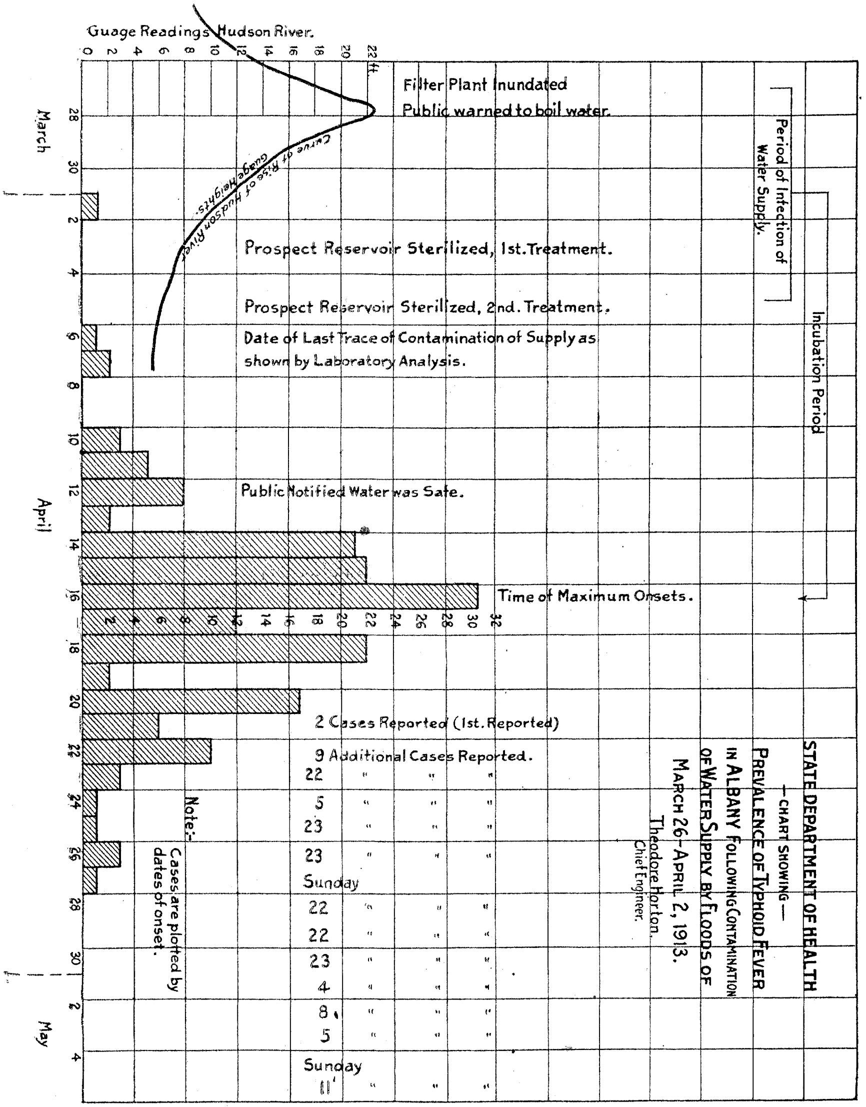
[1] This report was originally published May 15, 1913, in the Engineering News, through the courtesy of which it is here reprinted with the permission of the author.

On the diagram have been plotted two curves or profiles, one showing the rise and fall of the Hudson River covering the period of the recent flood, the other the number of cases of typhoid which have developed in the city up to May 5, inclusive, so plotted as to correspond with the dates of onset of the disease. On the diagram



also appear a number of explanatory notes relating to water supply and typhoid fever, arranged chronologically so as to show directly the relation between the two as to cause and effect. The vertical notes on the diagram explain important facts with reference to the flooding of the filter plant, notice to boil water, sterilization of Prospect

Reservoir, the clearing up of all traces of pollution of the water-supply system, whereas the horizontal notes at the top of the diagram explain the relation between the incubation period, the period of infection of the supply, and the time of maximum prevalence of typhoid fever.

This diagram strikingly pictures what occurred. It will be noticed that the maximum number of cases had their onsets on April 16 and the period of maximum prevalence covered a period of about one week. Allowing some two weeks for "incubation" and dating back on the diagram this period of time from April 16 brings us directly to the period when infection of the water supply took place. The diagram shows, therefore, at a glance the close synchronous relation between the infection of the supply and the outbreak of cases.

Many things of unusual interest from an epidemiological standpoint occurred during the epidemic and appear on the chart that merit careful consideration, and I will refer to them somewhat in detail.

The inundation of the filtration plant came with comparatively little warning and there was little time to notify the public to take precautions to boil the water. The city was substantially free from typhoid fever and the public mind was not, and could hardly be expected to be, aroused to the point of absolute necessity of observing precautions as it would have been had a typhoid fever epidemic been in progress, with the usual alarm that such a condition incites. It is therefore not surprising that in view of the warnings which appeared immediately in all of the papers " to boil the water " these precautions were not strictly observed, as was obvious from the cases which developed later. (See diagram.)

Another feature in this connection is the large percentage of children who were stricken, 75 per cent. This is also what would have been expected by anyone familiar with the juvenile mind. Children seem to have a particular aversion to boiled water, owing to its insipidity when not properly prepared and aerated. Contamination lingered in the water-supply system (due to raw river water getting into Prospect Reservoir) some days after the high turbidity, at first apparent, cleared up. It is therefore easy to understand, as the records show, why children disregarded instructions and drank the more palatable water from the tap.

Another feature of much interest and importance, and referred to in detail in Engineering News of April 10, was the sterilizing of Prospect Reservoir for correcting the contamination and the institution of a series of laboratory analyses by the State department of health for the purpose of establishing a means whereby it would be possible to determine when the water supply was safe and the boiling of water unnecessary.

It will be recalled that the situation in the city was referred to the department by the governor in order that cooperation and counsel might be given the local authorities to avoid an epidemic. Although the damage had already been done, the extent of it did not develop for two or three days. A close cooperation was, however, at once instituted between the city and State departments of health. The filter plant was put in service as soon as the water receded sufficiently, the public having already been warned to boil all drinking water. A temporary hypochlorite disinfecting plant was installed within 24 hours following. Flushing of water mains was immediately proceeded with. A plan was at once put into execution for systematically analyzing samples of water to be collected daily from the reservoirs and various taps over the entire city.

With the public already warned, and steps taken to put the filter plant into operation and thus furnish a pure supply to the city within a comparatively few hours of the time of recession of the flood, attention was immediately turned to investigating and clearing up the contamination which was known to have lingered in the distributing system. It was not for some two or three days, however, that the extent and seriousness of the contamination of one of the reservoirs were discovered and measures taken to correct it. The laboratory results revealed this and the local authorities were notified that the reservoir must be shut off or its sterilization undertaken without delay. Unfortunately the piping arrangements made shutting off the reservoir impracticable. Sterilization was therefore resorted to and was undertaken first on April 3. This was followed two days later by another treatment. I believe this is the first case on record of sterilization of a large open reservoir by the hypochlorite method, and the results show that two treatments of about 1 part per million accomplished an entire elimination of *Bacillus coli* type and acid colonies from the water in the reservoir.

The analyses from various parts of the distribution system in the city showed that whereas practically all traces of contamination disappeared from the central portion of the distributing system by April 4, there still remained traces on the periphery of the system. The city was then requested to flush again the pipes in the outlying sections of the system. As a result, by April 7 practically no trace of contamination was found in the reservoirs or any portion of the distributing system. Not until five days later, however, was the public notified that the water was safe to drink without boiling. This additional time was given as a factor of safety and with the idea that by waiting the full period of two weeks some indication might be obtained as to whether infection had occurred to any appreciable extent.

This brings me to one of the most important features in connection with the outbreak, namely, that although there were some 12 to 15 cases of typhoid fever actually in progress at the time that the people were notified that the water was safe, no cases were reported by the physicians until about April 21, when, as shown by the diagram, over 150 cases were in progress and the crest of the epidemic had apparently passed. In other words, the epidemic, so far as the evidence now available indicates, had largely disappeared before the cases had begun to be reported. Of course, some time is necessary for diagnosis, but an important question apparently arises as to how much time is necessary for this purpose, and especially as to whether in an emergency like this physicians can not make their diagnoses more promptly and whether they should not err on the safe side and report even suspicious cases. A glance at the diagram would indicate that in the present case there was considerable delay in the reporting of cases.

As an interesting side light on this particular feature, note on the diagram how few cases of onsets appear on April 13, 17, and 19. The dates of onsets are by nature necessarily approximate, and I am inclined to explain the low numbers on such dates as due to possible psychological tendency, in reporting approximate dates of onsets, to select even numbers for dates, with the exception, perhaps, of the 15th or middle of the month.

This epidemic is not devoid of a number of lessons which all such experiences seem to furnish, among which might be mentioned in order the following:

(1) That in designing purification works situated under conditions as at Albany it is better to arrange them with a greater factor of safety against inundation, the recent flood having overtopped the tops of the filters a little over 1 foot.

(2) That sufficient available storage for a few days' supply might well be provided where there is any question as to inundation of purification works or other necessity for using impure raw water.

(3) That all reservoirs should be arranged so that they may be entirely shut off from the distribution system in case of such emergency.

(4) That a mere warning to "boil water" when an epidemic is not in progress does not seem to deter a great many people from using contaminated water and makes all the more emphatic the necessity of maintaining at all times the integrity of purification works.

(5) That it is possible to sterilize effectively a large reservoir of water by hypochlorite treatment with fair success and that such emergency means should always be kept in mind by those responsible for its use in such cases.

(6) That physicians should be more prompt in reporting cases of typhoid fever, especially at a time when an infection of a water supply has been possible. Time is necessary of course for diagnosis but even suspects should be reported in such emergency. More could, of course, be said in this respect since it is far-reaching.

(7) Local boards of health should be so provided with funds and facilities as to furnish at once the necessary information to follow closely from day to day the progress of an epidemic in order that they may take the necessary means for its suppression.

(8) The State after passing laws controlling the reporting of cases of communicable diseases should not by a series of exemptions make those laws applicable to only a part of the State.

(9) The people who drink water unboiled in an emergency like this in utter disregard of warnings from municipal and State authorities deserve to be severely criticized.

Fortunately, so far as the water supply is concerned, this outbreak appears to be largely if not almost entirely spent. With the water supply free from contamination, if secondary cases can be avoided and milk infection be prevented there would seem little to be feared from now on. The State commissioner of health has recently issued two letters of a general nature—one to each physician of the city of Albany urging all possible precautionary measures to prevent a spread through secondary infection, the other to all milkmen supplying milk in the city giving them instructions how to prevent an infection of their supply, sterilization of milk bottles by boiling water or steam, not leaving or taking milk bottles from houses containing typhoid patients, and excluding typhoid cases or suspects from handling milk or milk utensils, with the warning that any infected supply found would be promptly excluded. Included in the letter of advice to physicians was the following suggestion:

> I venture to suggest that it would be well for you to administer typhoid vaccine to all of the members of every household in which you have under your care a case of typhoid fever. This department has a supply of typhoid vaccine now on hand and will be pleased to furnish it upon request to all of the practicing physicians of the city for general use at this time.

No mention has been made of a consideration of other factors than water infection, nor, in fact, would any seem necessary. All such factors were, of course, carefully considered. Milk from the considerable number of sources used by the different cases showed no route in any particluar way associated with the epidemic. Many spring and well waters were used during the flood when city water was roily, and these were peddled through the city from various sources outside the city. The possibility of these being a contributory cause of outbreak is not remote, but on the face of it such waters could not have been polluted like the raw river water, nor could they all have been infected; furthermore, analyses which were taken of a number of them did not show any to be appreciably contaminated. None were associated with any "route."

Oysters were peculiarly a factor for consideration from the fact that one large hotel and one or two business places had oysters stored in the cellars which were flooded. No trace could be found, however, connecting these oysters with any case of typhoid fever in the city.

All of the cases have been plotted on a map of the city, which shows a fairly uniform distribution over the city—a typical "water infection" typhoid map, with, however, a preponderance of cases on the portion of the system connected with Prospect Reservoir. This fits perfectly the situation, since Prospect Reservoir was contaminated and contamination lingered and entered its portion of the system until this reservoir was sterilized. Of course contamination entered the other portion of the distribution system connected with Bleeker Reservoir, and this contamination accounts for the cases on that system. The important point is, however, that the analyses showed that Bleeker Reservoir was not contaminated, as was the case of Prospect Reservoir (due to Bleeker Reservoir receiving a part of its supply from an upland gravity source, Rensselaer Lake, there being pumped into the distribution system connected with Bleeker Reservoir only an amount of water necessary to make up a deficiency in supply), so that the infection disappeared rapidly from the system connected with Bleeker Reservoir as soon as the filtration plant was put into normal operation. The distribution systems of the Bleeker and Prospect Reservoirs are entirely separated, about one-half the city's population being served by Bleeker and one-half by Prospect. With, therefore, three-fourths of the cases on Prospect and one-fourth on Bleeker, we have by comparison an indication of the relative significance of the contamination that entered Prospect Reservoir.

Although it is too early to say definitely that the epidemic is entirely over, the records of the local health department show that it has largely subsided. That is, the reported cases for the past four or five days show that only 4 or 5 cases have been reported each day, as compared with the 22 to 25 cases of a week or more ago. It may also be stated that many of these cases reported within the past few days date back for onsets toward the middle of April, the time of maximum prevalence as shown by the diagram.

Additional cases must almost of necessity continue to be reported in the future, but one would expect (I hardly dare express it more positively) them to be straggling reports either of cases with old onsets or else secondary cases from previous victims. It may at least be expected that with the full and explicit notices sent out by the State commissioner of health to the practicing physicians of the city and similar notices to the milkmen supplying milk, the avenues of infection and further spread of the disease will be effectually cut off.